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# Mac OS X

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# BRL-CAD & Mac OS X

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## Topics:

- Apple Computer, Inc's new platform
- Architecture considerations
- BRL-CAD and UNIX
- The actual port to Mac OS X
- Performance issues
- Future direction



# Apple Computer, Inc.

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“Mac OS X is a modern operating system that combines the power and stability of UNIX with the simplicity and elegance of the Macintosh.”



Apple is the largest UNIX-based platform vendor on the planet.



# Mac OS X

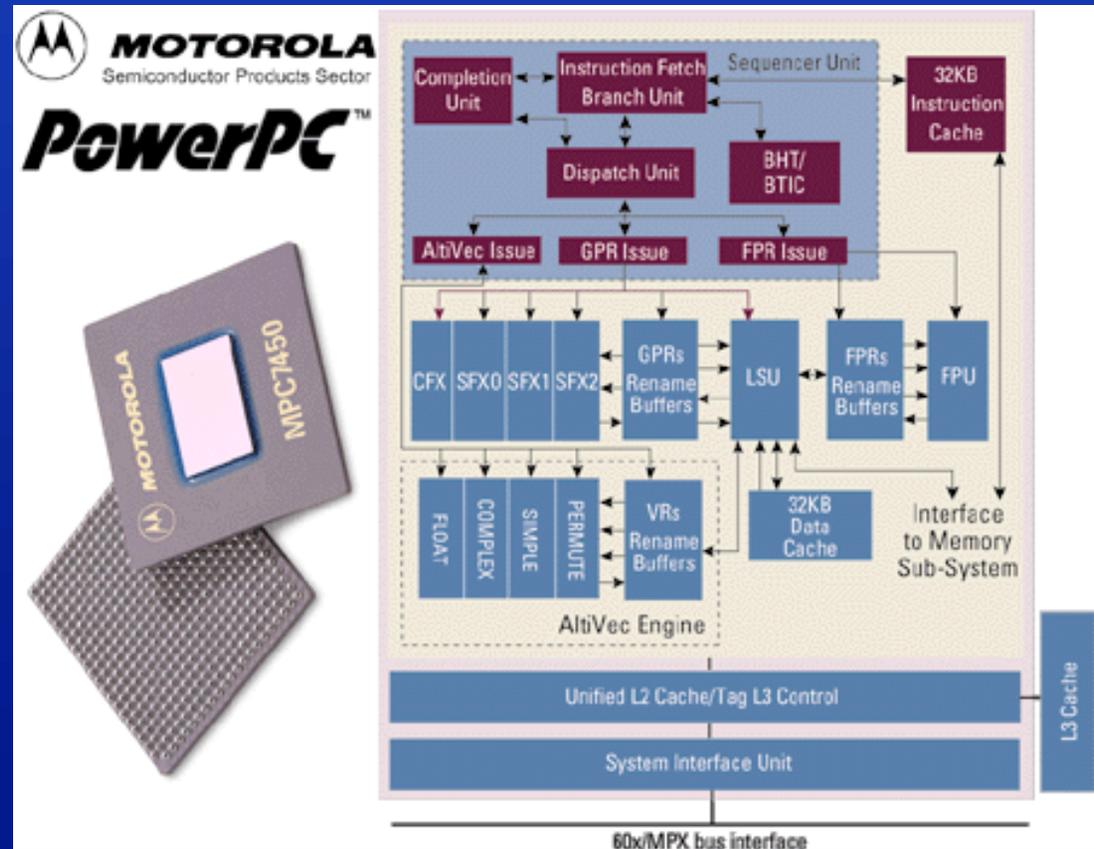
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- New BSD-based operating system
- Open-source kernel (Darwin), some libraries and APIs as well
- Standards compliance
  - OpenGL, POSIX, MPEG4, Java2, IPv6, LDAPv3, IPsec, SSL, SSH2, ...
- Interoperability with Windows and UNIX
- Popular commercial software available
  - Word, Excel, PowerPoint, Internet Explorer, Photoshop, Mathematica, Pagemaker, InDesign, ...



# Multiprocessing & More

- Symmetric multiprocessing architecture available
- AltiVec vector pipeline (aka Velocity Engine™)





# Darwin

- Core open-source operating system
- X Server support
  - Xdarwin and XonX
- POSIX standard compliance supported
  - Threading (POSIX and Mach threads available)
  - Shell
  - sysctl interface
- OpenGL support
  - hardware accelerated, double-buffered windows, per-pixel alpha channel & fade control, and more...
  - Quartz extreme





# Darwin

Classic	Carbon	Cocoa	Command Line	GTK & KDE
Platinum		Aqua	Terminal Window	Window Manager
QuickDraw		Quartz	Shell (csh, bash, etc.)	XDarwin
<b>Darwin (Core Operating System)</b> Based on BSD 4.4 - Mach 3.0 Micro Kernel				



# BRL-CAD & UNIX

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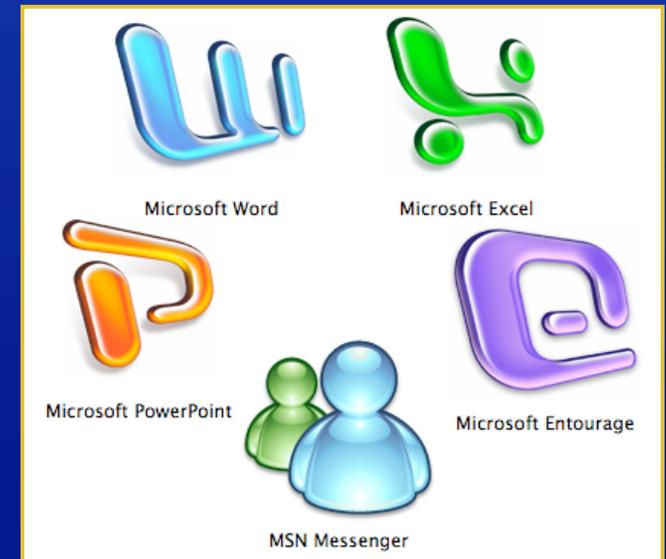
- BRL-CAD is designed to work best in a UNIX-based environment
- **Many** compact and well-defined tools that perform particular tasks
- Presently **397** tools, utilities, commands, ...
- Commands may be chained together for flexible usage





# Why Mac OS X?

- Open standards compliance
  - **It is UNIX based**
    - It has a POSIX command line interface and tools
  - Apple has a respectable history of reliability and “good design” in both software and hardware
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- It runs Microsoft Office, Photoshop, Mathematica, ...
- 
- It's the largest UNIX-based platform





# The Port

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- Bulk of work (90%) was done in less than half an hour
- Iterative and incremental approach
- Files modified:
  - sh/machinetype.sh
  - Cakefile.defs
  - h/conf.h
  - h/machine.h
  - libbu/parallel.c
  - libfb/...
  - libdm/...



# Iterative and Incremental Process

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- Get `sh/machinetype.sh` to work
- Run `setup.sh` successfully
  - Get `cake` to work
- Stub a base configuration into `Cakefile.defs`
- Add architecture details to `h/machine.h`
- Compile, modify `h/conf.h`, and repeat ... until all errors and (most) warnings are eliminated



# Problems Encountered

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- Adding the architecture piece-wise unveiled assumptions and dependancies that were not expected
  - E.g. X Windows support on UNIX
- Subtle bugs (some nasty) that were not evident on other platforms emerged
- Those problems have been fixed



# Extra Functionality Needed

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- Multiple processor support (SMP) working
  - Modified `bu_avail_cpus()` in `libbu/parallel.c`
- Added something more functional than the debug framebuffer
  - Added X Windows support configuration options
  - Add OpenGL support configuration options
- Other ideas for later ...



# Performance

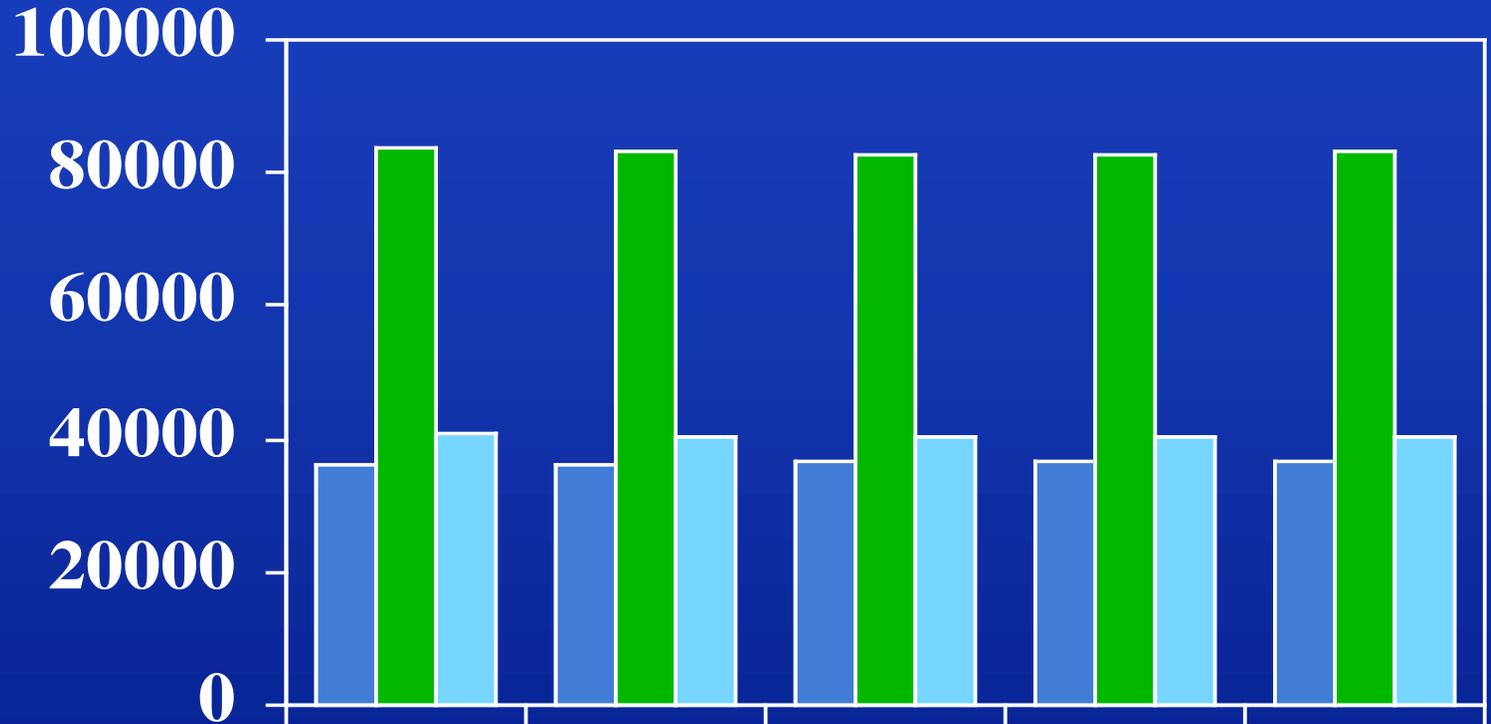
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- Running the BRL-CAD benchmark
  - bench/run.sh actually runs the test
    - results stored in the file named “summary”
  - bench/try.sh invokes the benchmark run interactively, opening up a window per image
    - For the time being, you will need X Windows to be installed
- Interpreting the results
  - Apple has done impressive optimizations
    - Uses the open source GNU Compiler Collection (GCC 3.1)
  - The hardware takes significant advantage of L2 cache available
    - G4 500’s have 1MB unified L2 cache per chip
    - G4 800 and 1000’s have 256KB L2 cache and 1MB L3 cache



# Benchmark Results

average rays/second (rtfm)



■ G4 500	36354	36177	36495	36631	36525
■ Dual G4 500	83633	83100	82675	82905	83169
■ G4 800	40722	40430	40490	40456	40440



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# Demo



# Comparison to Linux on PPC

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- Yellow Dog Linux 2.3 with default install gave approximately 25% slower runtime performance
- Compiles significantly faster than Darwin
  - 25 minutes as opposed to 1.5 hours
- Hints that Apple has better compiler optimizations and perhaps better run-time libraries



# Future work

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- Use Project Builder compilation environment coupled with GNU's autotools
- Integrate AltiVec vector pipeline support into math operations
- **Relinquish dependancy on X**
  - Create libfb and libdm interface for Aqua
  - Use AquaTk



# Use Aqua Interface

Classic	Carbon	Cocoa	Command Line	GTK & KDE
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QuickDraw	Quartz		Shell (csh, bash, etc.)	XDarwin
<b>Darwin (Core Operating System)</b> Based on BSD 4.4 - Mach 3.0 Micro Kernel				



Think different.